INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

LCS-CC SERIES

G-R SYSTEM

LAMBDA

LAMBDA ELECTRONICS CORP.–MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL
FOR
REGULATED POWER SUPPLIES

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This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics Corp. All information contained herein applies to all LCS-CC models unless otherwise specified.

LAMBDA ELECTRONICS CORP. MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

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SPECIFICATIONS AND FEATURES

Specifications apply for all models.

DC OUTPUT — Voltage regulated for line and load.

TABLE I
VOLTAGE AND CURRENT
RANGES

MODEL	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LCS-CC-2	2 ±5%	16.0	14.5	12.7	10.5
LCS-CC-5-OV	5 ±5%	16.0	14.5	12.7	10.5
LCS-CC-6	6 ±5%	15.2	13.8	12.1	10.0
LCS-CC-12	12 ±5%	10.5	9.4	8.2	5.0
LCS-CC-15	15 ±5%	9.5	8.6	7.4	4.8
LCS-CC-20	20 ±5%	7.7	7.2	6.5	4.4
LCS-CC-24	24 ±5%	6.8	6.4	5.7	4.4
LCS-CC-28	28 ±5%	6.0	5.6	5.0	4.3
LCS-CC-48	48 ±5%	3.7	3.4	3.0	2.2
LCS-CC-01	0-7	9.2	8.3	7.4	6.3
LCS-CC-02	0-18	3.8	3.5	3.2	2.7
LCS-CC-03	0-32	2.3	2.1	1.9	1.6

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation (line) ..... 0.01 percent plus 1.0 millivolt for input variations from 105-132 or 132-105 volts AC.

Regulation (load) ..... 0.01 percent plus 1.0 millivolt for load variations from no load to full load or full load to no load.

Remote Programming

External Resistor ..... Nominal 1000 ohms/volt output

Programming Voltage ..... One-to-one voltage change.

Ripple and Noise ..... 250 microvolts rms; 1 millivolt peak to peak at 57-63 Hz input with either positive or negative terminal grounded.

Temperature Coefficient ..... Output change in voltage (0.01% + 0.3 mv)/°C.

Remote Sensing ..... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

AC INPUT — 105-132, 205-265 or 187-242 ("V" option) volts AC at 47-440 Hz. Input Power: 300 watts.* For operation at 47-53 Hz, derate current 10% for each ambient temperature given in table I. For 63-440 Hz operation, consult factory.

* With output loaded to full current rating and input voltage, 132 volts AC, 60 Hz.

OVERLOAD PROTECTION

Thermal ..... Thermostat, resets automatically when over temperature condition is eliminated.

Electrical
External ..... Automatic electronic current limiting circuit, limits output current to a preset value less than 110% of 40°C current rating. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — Model LCS-CC-5-OV includes a fixed built in overvoltage protection circuit which prevents damage to the load caused by excessive power supply output voltage. Overvoltage protection firing range is between 6.2 and 7.4 volts D.C.

INPUT AND OUTPUT CONNECTIONS — Terminal block on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from -20°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE — -55°C to 85°C (non-operating)

CONTROLS

DC output control ..... Voltage adjust control permits adjustment of DC output voltage via access hole located in nameplate.

PHYSICAL DATA

Size	4-15/16" x 4-15/16" x 9-3/8"
Weight	15 lbs. net; 17 lbs. shipping
Finish	Grey, FED. STD. 595 No. 26081

MOUNTING — Three surfaces, each with tapped mounting holes can be utilized for mounting this unit. All LCS-CC power supplies can be mounted with Top, Front, or Right Side facing up. Top, Front, or Right Side must be in a horizontal plane. Refer to figure 13 for mounting details.

MODEL OPTIONS

"J" Option	Standard LCS-CC power supplies can be obtained for 90-110 VAC, 47-440 Hz input. For operation at 47-53 Hz, derate current 10% for each ambient temperature given in table I. For 63-440 Hz operation, consult factory.
"V" Option	Standard LCS-CC power supplies can be obtained for 205-265 VAC, 47-440 Hz input or 187-242 VAC, 47-440 Hz input. See nameplate for AC input rating. See schematic diagram for rewiring of AC input. For operation at 47-53 Hz, derate current 10% for each ambient temperature given in table I. For 63-440 Hz operation, consult factory.
"S" Option (LCS-CC-5-OV — LCS-CC-48 Only)	Fixed voltage LCS-CC power supplies must be specified with the "S" option when used with the Systems Power Sequencer. On units with "S" option, resistor R20 is jumped, see schematic diagram.

ACCESSORIES

Rack Adapters	Rack adapters LRA-6, LRA-10, LRA-11, and LRA-13 used for ruggedized mounting with or without chassis slides are available as well as rack adapter LRA-3, which is used for simple rack installations where chassis slides are not required.
Overvoltage Protectors	Externally mounted, Overvoltage Protectors LMOV-1, LMOV-2, and LMOV-3 are available for use with models LCS-CC-2 and LCS-CC-6 through LCS-CC-48 power supplies. On models LCS-CC-01 through LCS-CC-03, use Overvoltage Protectors LHOV-4 and LHOV-5.

GENERAL

The Lambda power supply consists of an AC input circuit and transformer; a bias supply consisting of an auxiliary rectifier, and pre-regulator*; a drive supply consisting of a rectifier and filter**; a main regulator circuit consisting of the main rectifier and filter, a series regulator, emitter follower driver, a current comparator*, a voltage comparator*, an amplifier*, current and voltage sensing networks and a voltage reference circuit*.

*This circuit element is part of integrated circuit (IC1) in the supply.
**LCS-CC-2, LCS-CC-5-OV, LCS-CC-6, and LCS-CC-01 only.

The circuit arrangement is shown in block diagram form, Figure 11. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Single phase input power is applied to transformer T1 through the input circuit which contains a thermostat to protect the supply against over heating.

The main rectifier, a full wave rectifier, provides the power which is filtered by capacitor C6, and then regulated via a series regulator and delivered to the output. Half-wave auxiliary rectifier CR1 provides voltage filtered by capacitor C1 for the preregulator located in IC1. The reference element, powered by the preregulator, provides a reference voltage for the current comparator and the voltage comparator. Full wave drive rectifier CR23, CR24 provides voltage filtered by capacitor C34 for drivers Q1, Q2.

Constant voltage circuit operation is determined by changes in the load which cause a change in one input to the voltage comparator. A second input to comparator is a reference voltage that is developed by a constant current of 1 milliampere flowing in divider elements R8, and, as applicable, R20. The comparator compares the output voltage change with the reference voltage resulting in an error signal at the output of the comparator.

The error signal from the comparator is then current amplified by drivers Q1 and Q2. The amplified signal from the drivers controls the voltage across the series regulators Q6 through Q9, which function as the active regulating elements in the supply.

* Current limit circuit operation for models LCS-CC-2 through LCS-CC-48 is determined by changes in the load. The current comparator samples load current through current sensing resistor R25. When the voltage drop across R25 increases to the preset voltage reference determined by R6, R9, R13, and R21, the current comparator conducts. Thus, when the output current rating of the unit is exceeded, the current comparator conducts, decreasing the current through drivers Q1 and Q2, resulting in an increase of voltage across the series regulator and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by fixed resistors R6, R25, R9, R21, and variable resistor R13.

When operating conditions approach short circuit, the output voltage decreases. Since the voltage determined by R13 is porportional to the output voltage, when the output voltage decreases, the amplifier is biased into turn on at lower and lower load currents until output voltage decreases to zero and current decreases to a predetermined low value.

* The following theory applies to models LCS-CC-01 through LCS-CC-03.

Current limit circuit operation is determined by changes in the load. When load current increases above the rated current value, the voltage drop across current limit potentiometer R13 increases causing the amplifier to turn on. With the amplifier conducting the current to driver Q1 and Q2, decreases, limiting the base current to series regulators Q6 through Q9 which results in an increase of voltage across the series regulators and a decrease of the output voltage, effectively limiting the output current to a safe value. The current limit value is determined by the factory setting of current limit potentiometer R13.

When operating conditions reach short circuit, the output voltage value decreases to zero and the current remains at the current limit value.

OV CIRCUIT, FUNCTIONAL DESCRIPTION (LCS-CC-5-OV ONLY)

When the power supply output voltage increases above zener breakdown voltage of CR28 (approximately 6.2 volts) and gate voltage of SCR1 (approximately 0.6 volts), CR28 conducts and current is supplied to the gate of SCR1. SCR1 fires, causing the power supply output voltage to drop.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature and will remain limited to less than 110% of 40°C rating.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying AC input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output terminal grounded. Both positive and negative ground connections are shown in the diagrams for all suggested output connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the ungrounded (hot) lead to terminal 1.

The supply positive terminal is brought out to terminal 6. The supply negative terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 10. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. The local sensing connection is the connection suitable for applications with relatively constant load.

Remote Sensing Connection, Figure 4. The remote sensing connection provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at 1000 ohms/volt and a shorting-type switch as shown in Figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation. Before programming, adjust programming resistor for zero resistance.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Fig. 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply.

The programming supply must have a reverse current capability of 1.5 ma minimum.

Alternatively, when supplies with less than 1.5 ma reverse current capability are used, a resistor capable of drawing 1.5 ma at the minimum programming voltage must be connected across the output terminals of the supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections for Series Operation

The voltage capability of LCS-CC power supplies can be extended by series operation. A maximum of 300 volts can be connected between either the +DC or -DC terminal and chassis ground.

Figure 7, and as applicable, 8, shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

Figure 7 applies only to the LCS-CC-01 through LCS-CC-03 power supplies. If a common load is used, the maximum current rating of the unit with the lower current rating must not be exceeded.

Figure 8 shows the series connection applicable to the LCS-CC-2 through LCS-CC-48 power supplies. A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 8. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of "Specifications and Features" for power supply current and voltage ratings.

Connections for Parallel Operation (Applicable only to LCS-CC-01 — LCS-CC-03)

The current capability of LCS-CC power supplies can be extended by parallel operation of LCS-CC power supplies of equal* voltage capacities. Units "M" and "S" are shown connected for parallel operation in figures 9 and 10. One power supply designated "M" unit controls its own output as well as the output of the second power supply, designated the "S" unit.

* For applications using supplies of unequal voltage ratings, consult factory for details of operation.

Unit S operates to regulate its current in a ratio to that of the M unit by comparing the current in its internal sampling resistor with that current sampled by the master internal sampling resistor.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown

The thermostat opens the input circuit only when the temperature of the internal heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value. After eliminating the cause(s) for overheating and allowing time for the power supply to cool to a proper temperature, resume operation of the supply.

Overvoltage Shutdown

When the power supply output voltage increases above the overvoltage limit, SCR1 will short circuit output of the supply. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the AC input circuit.

GENERAL

This section describes trouble analysis routine, replacement procedures, calibration and test procedures that are useful for servicing the Lambda LCS-CC power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on specifications and features for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check fuse, primary power lines, external circuit elements, and external wiring for malfunction before trouble shooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumper and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 12, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an instrument that has a highly limited current capability. Observe proper polarity to avoid error in measurement. The forward transistor resistance is low but never zero; backward resistance is always higher than the forward resistance.

For good transistors, the forward resistance for any junction is always greater than zero.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional defective components could damage the replaced component.

When soldering semi-conductor devices, wherever possible, hold the lead being soldered with a pair of pliers placed between the component and the solder joint to provide an effective heat sink.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needlepoint probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to the measuring instrument.

3. Wherever possible use a heat sink when soldering transistors.

4. Broken or damaged printing wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes, and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) AC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
1. Zero volts DC output	OUTPUT VOLTAGE control turned fully CCW	Check OUTPUT VOLTAGE control for proper setting & correct as necessary.
	Short circuit across output of supply	Check load & load connections, correct as necessary.
	Series regulator section open	Check Q6 through Q9 and R25 through R28 for open, replace as necessary.
	Shorted CR7	Check CR7 for short, replace as necessary.
	Current sensing resistor open	Check R25 for open, R6 for short
	Aux. rectifier CR1 open	Check CR1 for open, replace as necessary.
	Open CR8, CR9, or R1	Check & replace as necessary.
2. Unable to adjust adjust voltage	Damaged OUTPUT VOLTAGE control	Check R8 for short or open, replace as necessary.

TROUBLE SHOOTING CHART

Symptom	Probable Cause	Remedy
3. High ripple at line frequency or twice line frequency & unregulated DC output	Series regulator transistors shorted	Check and replace as necessary; Q1, Q2, Q6 through Q9
	Defective main rectifier causes ripple at twice line frequency.	Check for open and/or short CR2, CR3, CR4 & CR5.
4. Same as 3, except intermittent	Foreign matter fallen into unit	Check for loose bench hardware & wire clippings that may have fallen through cover.
5. High ripple at frequency other than line or twice line frequency	Oscillation due to defective component in filter network	Check for open C14, C2 & check for open and/or short in C11 & R2. Replace defective component.
6. Large spikes at output	Capacitor C15 and as applicable, C16 open.	Replace C15 (and C16).

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 12. Use suggested test equipment or equivalent to obtain accurate results. Refer to Specifications and Features for minimum performance standards.

Set the differential meter, DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the load to no-load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a Variac to vary the line voltage from 105-132 or 132-105 volts AC and check the power supply line regulation accuracy on the DVM differential meter.

Use a VTVM, Ballantine 320 or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R13

Whenever Q6 through Q9, R6, R25 through R28, R9, R13, R21, or IC1 are replaced, and voltage and current indications do not reflect maximum ratings, adjust R13 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove AC input power to the supply.

2. Break seal on wiper of R13 from resistor housing and turn to full CW position.

3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load.

4.* Turn voltage adjust control until minimum rated output voltage is obtained.

5.* Apply load so that output current is 110% of 40°C rating for the unit.

6.* Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R13 in CCW direction. Adjust R13 until output ripple increases sharply and oscilloscope pattern changes.

7.* After adjustment is completed, remove AC power input to the supply and use glyptol sealant to seal wiper of R13 to resistor housing.

8.* After sealing, check setting and repeat adjustment procedure if required.

* Perform alternate steps 4A through 9A for adjustment of R13 on models LCS-CC-01 — LCS-CC-03.

4A. Turn voltage adjust control until rated output is obtained.

5A. Apply load so that output current is 110% of 40°C rating for the unit.

6A. Using an oscilloscope, Tektronix 503 or equivalent, observe unit output voltage while adjusting R13 in a CCW direction. Adjust R13 until output ripple increases sharply and oscilloscope pattern changes.

7A. Place a DC ammeter of appropriate scale across output terminals 4 and 6 of the supply. The meter indication shall be a maximum of 115% of 40°C rating for the unit.

8A. After adjustment is completed, remove AC input power to the supply and use glyptol sealant to seal wiper of R13 to resistor housing.

9A. After sealing, check setting and repeat adjustment procedure if required.

SERVICE

When additional instructions are required or repair service is desired, contact the nearest office of the Lambda Electronics Corp. where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.

2. Lambda part number.

3. Description of part together with circuit designation.

4. If part is not an electronic part, or is not listed, provide a description, function, and location of the part.

PARTS LIST

The electrical parts located on Lambda models LCS-CC-2 — LCS-CC-48 and LCS-CC-01 — LCS-CC-03 are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common-parts listing. In addition, there are separate listings of parts for the "J" and "V" options and LMOV and LHOV accessories.

COMMON PARTS
MODELS LCS-CC-2 — LCS-CC-6

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C1	Cap., elect., 40 mf -10+75%, 25 vdc	CBP-40-036	$ 1.20
C2	Cap., mylar, 0.047 mf ±10%, 200 vdc	CGL-47-018	.39
C3, C4	Not assigned		
C5	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012	.65
C6	Cap., elect., 60,000 mf -10+100%, 15 vdc	CBT-60-036	10.50
C7	Not assigned		
C9	Cap., elect., 2 mf -10+50%, 100 vdc	CBN-20-024	1.20
C10	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009	.50
C11	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001	.34
C12, C13	Not assigned		
C14	Cap., elect., 1,500 mf -10+100%, 25 vdc	CBS-15-078	2.50
C15, C16	Same as C5		
C17 thru C33	Not assigned		
C34	Cap., elect., 900 mf -10+100%, 35 vdc	CBR-90-040	2.27
CR1	Rectifier	FBL-00-030	1.40
CR2, CR3	Rectifier	FBL-00-083	2.75
CR4 thru CR7	Not assigned		
CR8	Same as CR1		
CR9	Not assigned		
CR10, CR11	Same as CR1		
CR12	Not assigned		
CR13	Same as CR1		
CR14 thru CR21	Not assigned		
CR22	Rectifier, zener diode	FBM-Z139	.27
CR23, CR24	Rectifier	FBL-00-094	.99
CR25 thru CR27	Not assigned		
IC1	Integrated circuit	FBT-00-031	9.75
Q1	Transistor, NPN	FBN-L109	2.25
Q2	Transistor, NPN	FBN-L144	3.81
Q3 thru Q5	Not assigned		
Q6 thru Q9	Transistor, NPN	FBN-36485	4.13
Q10 thru Q17	Not assigned		
Q18	Transistor, NPN	FBN-L110	$ 3.25
R1	Res., film, 8,660 ohms ±1%, ¼ w	DCS-87-071	.25
R2	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011	.10
R3, R4	Res., comp., 560 ohms ±10%, 1 w	DGB-5611	.24
R5	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021	.10
R6	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701	.06
R7	Not assigned		
R9	Res., film, 10,000 ohms ±1%, ¼ w	DCT-10-047	.20
R10	Res., comp., 36 megohms ±5%, ¼ w	DCB-3665	.19
R11	Not assigned		
R12	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831	.10
R13	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010	1.50
R14, R15	Not assigned		
R16	Same as R6		
R17 thru R19, R22	Not assigned		
R23	Res., comp., 4,700 ohms ±10%, ¼ w	DCB-4721	.24
R24	Not assigned		
R25 thru R28	Res., ww, 0.1 ohm ±5%, 5 w	DFM-10-074	.50
R29 thru R39, R41 thru R49	Not assigned		
R50	Res., ww, 0.4 ohm ±2%, 3 w	DFM-40-058	1.32
R51	Same as R5		
S1	Thermostat	FKA-148-030	1.41

COMMON PARTS (Cont.)
MODELS LCS-CC-2 — LCS-CC-6 (Cont.)

UNIQUE PARTS
MODEL LCS-CC-2

C8	Not assigned		
R8	Res., var., ww, 2,200 ohms ±5%, 2 w	DNS-22-056	2.50
R20	Res., film, 1,470 ohms ±1%, ¼ w	DCS-15-056	.45
R21	Res., film, 6,800 ohms ±2%, ¼ w	DCS-68-032	.30
R40	Not assigned		
T1	Transformer	ABA-LCSCC-2	42.00

UNIQUE PARTS (Cont.)

MODEL LCS-CC-5-OV

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C8	Cap., elect., 10 mf ±20%, 10 vdc	CBP-10-027	$ 2.00
CR28	Rectifier, zener diode	FBM-Z140	.27
R8	Res., var., ww, 4,500 ohms ±5%, 2 w	DNS-45-050	3.00
R20	Res., film, 3,830 ohms ±1%, ¼ w	DCS-38-060	1.50
R21	Res., film, 15,000 ohms ±5%, ¼ w	DCT-15-062	.15
R40	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011	.10
SCR1	Rectifier, silicon controlled	FBP-00-036	4.20
T1	Transformer	ABA-LCSCC-5	42.00

MODEL LCS-CC-6

C8	Not assigned		
R8	Res., var., ww, 4,500 ohms ±5%, 2 w	DNS-45-050	3.00
R20	Res., film, 3,830 ohms ±1%, ¼ w	DCS-38-060	1.50
R21	Res., film, 15,000 ohms ±5%, ¼ w	DCT-15-062	.15
R40	Not assigned		
T1	Transformer	ABA-LCSCC-5	42.00

COMMON PARTS

MODELS LCS-CC-12 and LCS-CC-15

C1	Cap., elect., 40 mf -10+75%, 25 vdc	CBP-40-036	1.20
C2	Cap., mylar, 0.047 mf ±10%, 200 vdc	CGL-47-018	.39
C3, C4	Not assigned		
C5	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012	.65
C6	Cap., elect., 22,000 mf -10+100%, 40 vdc	CBT-22-021	12.12
C7, C8	Not assigned		
C9	Cap., elect., 2 mf -10+50%, 100 vdc	CBN-20-024	1.20
C10	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009	.50
C11	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001	.34
C12, C13	Not assigned		
C14	Cap., elect., 900 mf -10+100%, 35 vdc	CBR-90-040	2.27
C15	Same as C5		
CR1	Rectifier	FBL-00-030	1.40
CR2 thru CR5	Rectifier	FBL-00-083	2.75
CR6, CR7	Not assigned		
CR8	Same as CR1		
CR9	Not assigned		
CR10, CR11	Same as CR1		
CR12	Not assigned		
CR13	Same as CR1		
CR14 thru CR21	Not assigned		

COMMON PARTS (Cont.)

MODEL LCS-CC-12 and LCS-CC-15 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
CR22	Rectifier, zener diode	FBM-Z139	$ .27
IC1	Integrated circuit	FBT-00-031	9.75
Q1	Transistor, NPN	FBN-L109	2.25
Q2	Transistor, NPN	FBN-36485	4.13
Q3 thru Q5	Not assigned		
Q6 thru Q9	Same as Q2		
R1	Res., film, 8,660 ohms ±1%, ¼ w	DCS-87-071	.25
R2	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011	.10
R3, R4	Res., comp., 1,800 ohms ±10%, 1 w	DGB-1821	.18
R5	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021	.10
R6	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701	.06
R7	Not assigned		
R8	Res., var., ww, 13,000 ohms, ±5%, 2 w	DNT-13-032	5.75
R9	Res., film, 10,000 ohms ±1%, ¼ w	DCT-10-047	.20
R10	Res., comp., 36 megohms ±5%, ¼ w	DCB-3665	.19
R11	Not assigned		
R12	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831	.10
R13	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010	1.50
R14, R15	Not assigned		
R16	Same as R6		
R17 thru R19	Not assigned		
R20	Res., film, 9,090 ohms ±1%, ¼ w	DCS-91-054	1.50
R21	Res., film, 50,000 ohms ±1%, ¼ w	DCT-50-054	.45
R22	Not assigned		
R23	Res., comp., 4,700 ohms ±10%, ¼ w	DCB-4721	.24
R24	Not assigned		
R25 thru R28	Res., ww, 0.22 ohm ±5%, 5 w	DFM-22-045	1.00
S1	Thermostat	FKA-142-015	2.50

UNIQUE PARTS

MODEL LCS-CC-12

T1	Transformer	ABA-LCSCC-12	42.00

MODEL LCS-CC-15

T1	Transformer	ABA-LCSCC-15	42.00

COMMON PARTS

MODELS LCS-CC-20 — LCS-CC-48

C1	Cap., elect., 40 mf -10+75%, 25 vdc	CBP-40-036	1.20
C2	Cap., mylar, 0.047 mf ±10%, 200 vdc	CGL-47-018	.39

COMMON PARTS (Cont.)
MODELS LCS-CC-20 — LCS-CC-48 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C3, C4	Not assigned		
C5	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012	$ .65
C7, C8	Not assigned		
C9	Cap., elect., 2 mf -10+50%, 100 vdc	CBN-20-024	1.20
C10	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009	.50
C11	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001	.34
C12, C13	Not assigned		
C15	Same as C5		
CR1	Rectifier	FBL-00-030	1.40
CR2 thru CR5	Rectifier	FBL-00-054	1.50
CR6, CR7, CR9	Not assigned		
CR10, CR11	Same as CR1		
CR12	Not assigned		
CR13	Same as CR1		
CR14 thru CR21	Not assigned		
CR22	Rectifier, zener diode	FBM-Z139	.27
IC1	Integrated circuit	FBT-00-031	9.75
Q3 thru Q5	Not assigned		
R1	Res., film, 8,660 ohms ±1%, ¼ w	DCS-87-071	.25
R2	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011	.10
R5	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021	.10
R6	Res., comp., 47 ohms ±10%, ¼ w	DCB-4701	.06
R7	Not assigned		
R9	Res., film, 10,000 ohms ±1%, ¼ w	DCT-10-047	.20
R10	Res., comp., 36 megohms ±5%, ¼ w	DCB-3665	.19
R11	Not assigned		
R12	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831	.10
R13	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010	1.50
R14, R15	Not assigned		
R16	Same as R6		
R17 thru R19, R22	Not assigned		
R23	Res., comp., 4,700 ohms ±10%, ¼ w	DCB-4721	.24
R24	Not assigned		
S1	Thermostat	FKA-142-015	2.50

UNIQUE PARTS
MODEL LCS-CC-20

C6	Cap., elect., 13,000 mf -10+100%, 60 vdc	CBT-13-023	11.67

UNIQUE PARTS (Cont.)
MODEL LCS-CC-20 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
C14	Cap., elect., 500 mf -10+100%, 60 vdc	CBR-50-041	$ 2.27
CR8	Rectifier	FBL-00-030	1.40
Q1	Transistor, NPN	FBN-L109	2.25
Q2, Q6 thru Q9	Transistor, NPN	FBN-36220	2.85
R3	Res., ww, 2,000 ohms ±3%, 3 w	DFS-20-032	.87
R4	Res., comp., 4,700 ohms ±10%, 1 w	DGB-4721	.24
R8	Res., var., ww, 15,000 ohms ±5%, 2 w	DNT-15-063	4.90
R20	Res., film, 15,000 ohms ±5%, ¼ w	DCT-15-062	.15
R21	Res., film, 66,500 ohms ±1%, ¼ w	DCT-67-074	.20
R25 thru R28	Res., ww, 0.39 ohm ±5%, 5 w	DFM-39-046	1.81
T1	Transformer	ABA-LCSCC-20	42.00

MODEL LCS-CC-24

C6	Cap., elect., 13,000 mf -10+100%, 60 vdc	CBT-13-023	11.67
C14	Cap., elect., 500 mf -10+100%, 60 vdc	CBR-50-041	2.27
CR8	Rectifier	FBL-00-030	1.40
Q1	Transistor, NPN	FBN-L109	2.25
Q2, Q6 thru Q9	Transistor, NPN	FBN-36220	2.85
R3	Res., ww, 2,000 ohms ±3%, 3 w	DFS-20-032	.87
R4	Res., comp., 4,700 ohms ±10%, 1 w	DGB-4721	.24
R8	Res., var., ww, 15,000 ohms ±5%, 2 w	DNT-15-063	4.90
R20	Res., film, 20,000 ohms ±1%, ¼ w	DCT-20-053	.20
R21	Res., film, 100,000 ohms ±1%, ¼ w	DCV-10-027	.45
R25 thru R28	Res., ww, 0.39 ohm ±5%, 5 w	DFM-39-046	1.81
T1	Transformer	ABA-LCSCC-24	42.00

MODEL LCS-CC-28

C6	Cap., elect., 13,000 mf -10+100%, 60 vdc	CBT-13-023	11.67
C14	Cap., elect., 500 mf -10+100%, 60 vdc	CBR-50-041	2.27
CR8	Rectifier	FBL-00-030	1.40
Q1	Transistor, NPN	FBN-L109	2.25
Q2, Q6 thru Q9	Transistor, NPN	FBN-36220	2.85
R3	Res., ww, 2,000 ohms ±3%, 3 w	DFS-20-032	.87
R4	Res., comp., 4,700 ohms ±10%, 1 w	DGB-4721	.24
R8	Res., var., ww, 15,000 ohms ±5%, 2 w	DNT-15-063	4.90

UNIQUE PARTS (Cont.)

MODEL LCS-CC-28 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R20	Res., film, 20,000 ohms ±1%, ¼ w	DCT-20-053	$ .20
R21	Res., film, 121,000 ohms ±1%, ¼ w	DCV-12-029	.20
R25 thru R28	Res., ww, 0.39 ohm ±5%, 5 w	DFM-39-046	1.81
T1	Transformer	ABA-LCSCC-28	42.00

MODEL LCS-CC-48

C6	Cap., elect., 4,000 mf -10+100%, 100 vdc	CBS-40-053	11.00
C14	Cap., elect., 200 mf -10+100%, 100 vdc	CBR-20-082	5.75
CR8	Rectifier	FBL-00-036	.60
Q1	Transistor, NPN	FBN-L115	2.75
Q2, Q6 thru Q9	Transistor, NPN	FBN-35902	6.15
R3	Res., ww, 5,600 ohms ±3%, 3 w	DFS-56-053	.60
R4	Res., ww, 9,000 ohms ±3%, 3 w	DFS-90-071	
R8	Res., var., ww, 23,000 ohms ±5%, 2 w	DNT-23-067	5.50
R20	Res., film, 40,200 ohms ±1%, ¼ w	DCT-40-058	.20
R21	Res., film, 121,000 ohms ±1%, ¼ w	DCV-12-029	.20
R25 thru R28	Res., ww, 0.5 ohm ±5%, 3 w	DFM-50-073	.50
T1	Transformer	ABA-LCSCC-48	42.00

COMMON PARTS

MODELS LCS-CC-01 — LCS-CC-03

C1	Cap., elect., 40 mf -10+75%, 25 vdc	CBP-40-036	1.20
C2	Cap., mylar, 0.047 mf ±10%, 200 vdc	CGL-47-018	.39
C3, C4	Not assigned		
C5	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012	.65
C7, C8	Not assigned		
C9	Cap., elect., 2 mf -10+50%, 100 vdc	CBN-20-024	1.20
C10	Cap., mylar, 0.033 mf ±10%, 400 vdc	CGL-33-009	.50
C11	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001	.34
C12, C13	Not assigned		
C15, C16	Same as C5		
C17 thru C33	Not assigned		
CR1	Rectifier	FBL-00-030	1.40
CR2, CR3	Rectifier	FBL-00-054	1.50
CR4 thru CR6	Not assigned		

COMMON PARTS (Cont.)

MODELS LCS-CC-01 — LCS-CC-03 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
CR7	Same as CR2		
CR8 thru CR11	Same as CR1		
CR12	Not assigned		
CR13	Same as CR1		
CR14, CR15	Not assigned		
CR16	Same as CR2		
CR17, CR20, CR21.	Not assigned		
CR22	Rectifier, zener diode	FBM-Z139	.27
IC1	Integrated circuit	FBT-00-031	9.75
Q3, Q4, Q10 thru Q17	Not assigned		
R1	Res., film, 8,660 ohms ±1%, ¼ w	DCS-87-071	.25
R2	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011	.10
R5	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021	.10
R6	Res., film, 249 ohms ±1%, ¼ w	DCR-25-034	.50
R7	Not assigned		
R9	Res., film, 10,000 ohms ±1%, ¼ w	DCT-10-047	.20
R10	Res., comp., 36 megohms ±5%, ¼ w	DCB-3665	.19
R11	Not assigned		
R12	Res., comp., 68,000 ohms ±10%, ¼ w	DCB-6831	.10
R13	Res., var., cermet, 100 ohms ±10%, 1 w	DRR-10-010	1.90
R14, R15	Not assigned		
R16	Res., comp., 470 ohms ±10%, ¼ w	DCB-4711	.10
R20 thru R22, R24, R29 thru R38, R40 thru R49	Not assigned		
S1	Thermostat	FKA-142-015	2.50

UNIQUE PARTS

MODEL LCS-CC-01

C6	Cap., elect., 60,000 mf -10+100%, 15 vdc	CBT-60-036	10.50
C14	Cap., elect., 1,500 mf -10+100%, 25 vdc	CBS-15-078	2.50
C34	Cap., elect., 900 mf -10+100%, 35 vdc	CBR-90-040	2.27
CR18, CR19	Not assigned		
CR23, CR24	Rectifier	FBL-00-094	.99
Q1	Transistor. NPN	FBN-L109	2.25
Q2	Transistor, NPN	FBN-36485	4.13

UNIQUE PARTS (Cont.)
MODEL LCS-CC-01 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
Q5	Not assigned		
Q6 thru Q9	Same as Q2		
Q18	Transistor, NPN	FBN-L110	$ 3.25
R3	Res., comp., 1,000 ohms ±10%, 1 w	DGB-1021	.15
R4	Res., ww, 150 ohms ±3%, 3 w	DFR-15-015	.15
R8	Res., var., ww, 9,000 ohms ±5%, 2 w	DNS-90-058	2.75
R17 thru R19, R23	Not assigned		
R25 thru R28	Res., ww, 0.22 ohm ±5%, 5 w	DFM-22-045	1.00
R39	Res., film, 100,000 ohms ±1%, ¼ w	DCV-10-027	.45
R50	Res., ww, 0.8 ohm ±2%, 3 w	DFM-80-062	.65
R51	Res., comp., 1,000 ohms ±10%, ¼ w	DCB-1021	.10
T1	Transformer	ABA-LCSCC-01	42.00

MODEL LCS-CC-02

C6	Cap., elect., 22,000 mf -10+100%, 40 vdc	CBT-22-021	12.12
C14	Cap., elect., 500 mf -10+100%, 60 vdc	CBR-50-041	2.27
CR18, CR19	Rectifier	FBL-00-030	1.40
Q1	Transistor, NPN	FBN-L109	2.25
Q2	Transistor, NPN	FBN-36485	4.13
Q5	Same as Q1		
Q6 thru Q9	Same as Q2		
R3	Res., comp., 3,300 ohms ±5%, 1 w	DGB-3325	.36
R4	Not assigned		
R8	Res., var., ww, 23,000 ohms ±5%, 2 w	DNT-23-067	5.50
R17	Same as R3		
R18	Res., comp., 820 ohms ±10%, ¼ w	DCB-8211	.06
R19	Res., comp., 220 ohms ±10%, ¼ w	DCB-2211	.10
R23	Not assigned		
R25 thru R28	Res., ww, 0.5 ohm ±5%, 3 w	DFM-50-073	.50
R39	Res., film, 100,000 ohms ±1%, ¼ w	DCV-10-027	.45
T1	Transformer	ABA-LCSCC-02	42.00

MODEL LCS-CC-03

C6	Cap., elect., 13,000 mf -10+100%, 60 vdc	CBT-13-023	11.67
C14	Cap., elect., 200 mf -10+100%, 100 vdc	CBR-20-082	5.75
CR18, CR19	Rectifier	FBL-00-030	1.40
Q1	Transistor, NPN	FBN-L115	2.75
Q2	Transistor, NPN	FBN-35902	6.15
Q5	Transistor, NPN	FBN-L109	2.25
Q6 thru Q9	Transistor, NPN	FBN-36220	2.85

UNIQUE PARTS (Cont.)
MODEL LCS-CC-03 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R3	Res., comp., 10,000 ohms ±10%, 1 w	DGB-1031	$ .13
R4	Not assigned		
R8	Res., var., cermet, 40,000 ohms ±10%, 2 w	DRT-40-047	4.75
R17	Same as R3		
R18	Res., comp., 820 ohms ±10%, ¼ w	DCB-8211	.06
R19	Res., comp., 220 ohms ±10%, ¼ w	DCB-2211	.10
R23	Res., film, 100,000 ohms ±1%, ¼ w	DCV-10-027	.45
R25 thru R28	Res., ww, 0.91 ohm ±2%, 3 w	DFM-91-060	.95
R39	Res., comp., 220,000 ohms ±10%, ¼ w	DCB-2241	.10
T1	Transformer	ABA-LCSCC-03	42.00

PARTS FOR "J" OPTION

On all LCS-CC models with suffix "J", transformer T1 changes. For transformer T1 used on these models, see standard LCS-CC model parts list for standard transformer part no. and add suffix "J" to the part no. Price for T1 does not change.

PARTS FOR "V" OPTION

On all LCS-CC models with suffix "V", capacitor C10 and transformer T1 change. Part no. change for C10 is listed here. For transformer T1 used on these models, see standard LCS-CC model patts list for the standard transformer part no. and add suffix "G" to the part no. Price for T1 does not change.

ALL MODELS

C10	Cap., paper, 0.01 mf ±10%, 1000 vdc	CAL-10-021	1.77

PARTS FOR OVERVOLTAGE PROTECTOR ACCESSORY MODELS LMOV-1, LMOV-2, LMOV-3, LHOV-4, LHOV-5

COMMON PARTS

C1	Cap., mylar, 0.01 mf ±20%, 80 vdc	CGL-10-008	.50
Q1	Transistor, NPN	FBN-L102	2.40
R3	Res., film, 200 ohms ±5%, ½ w	DCR-20-010	.20
R4	Res., thermistor, 425 ohms ±5%, 1¼ w	DKR-43-004	1.52
R5, R6	Res., comp., 1,200 ohms ±10%, ½ w	DEB-1221	.12
R8	Res., comp., 15,000 ohms ±10%, ½ w	DEB-1531	.12
R10	Same as R5		
SCR1	Rectifier, silicon controlled	FBP-00-009	6.00

UNIQUE PARTS
MODEL LMOV-1

Q2	Transistor, PNP	FBN-L103	1.76

UNIQUE PARTS (Cont.)

MODEL LMOV-1 (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
R1	Res., var., ww, 2,000 ohms ±10%, 1 w	DNS-20-034	$ 3.00
R2	Res., film, 560 ohms ±2%, ½ w	DCR-56-002	.65
R7	Res., comp., 33 ohms ±5%, ¼ w	DCB-3305	.15
R9	Not assigned		

MODEL LMOV-2

Q2	Transistor, PNP	FBN-L103	1.50
R1	Res., var., ww, 5,000 ohms ±10%, 1 w	DNS-50-036	3.15
R2	Res., film, 1,470 ohms ±1%, ½ w	DCS-15-031	.30
R7	Res., comp., 33 ohms ±5%, ¼ w	DCB-3305	.15
R9	Not assigned		

MODEL LMOV-3

Q2	Transistor, PNP	FBN-L114	3.50
R1	Res., var., ww, 20,000 ohms ±10%, 1 w	DNT-20-010	2.85
R2	Res., film, 4,700 ohms ±2%, ½ w	DCS-47-028	.30
R7	Res., comp., 39 ohms ±5%, ¼ w	DCB-3905	.15
R9	Res., comp., 22 ohms ±10%, ½ w	DEB-2201	.12

UNIQUE PARTS (Cont.)

MODEL LHOV-4

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.	UNIT PRICE
Q2	Transistor, PNP	FBN-L114	$ 3.50
R1	Res., var., ww, 10,000 ohms ±10%, 1 w	DNT-10-045	3.75
R2	Res., film, 560 ohms ±2%, ½ w	DCR-56-002	.65
R7	Res., comp., 33 ohms ±5%, ¼ w	DCB-3305	.15
R9	Res., comp., 22 ohms ±10%, ½ w	DEB-2201	.12

MODEL LHOV-5

Q2	Transistor, PNP	FBN-L114	3.50
R1	Res., var., ww, 20,000 ohms ±10%, 1 w	DNT-20-010	2.85
R2	Res., film, 560 ohms ±2%, ½ w	DCR-56-002	.65
R7	Res., comp., 33 ohms ±5%, ¼ w	DCB-3305	.15
R9	Res., comp., 22 ohms ±10%, ½ w	DEB-2201	.12

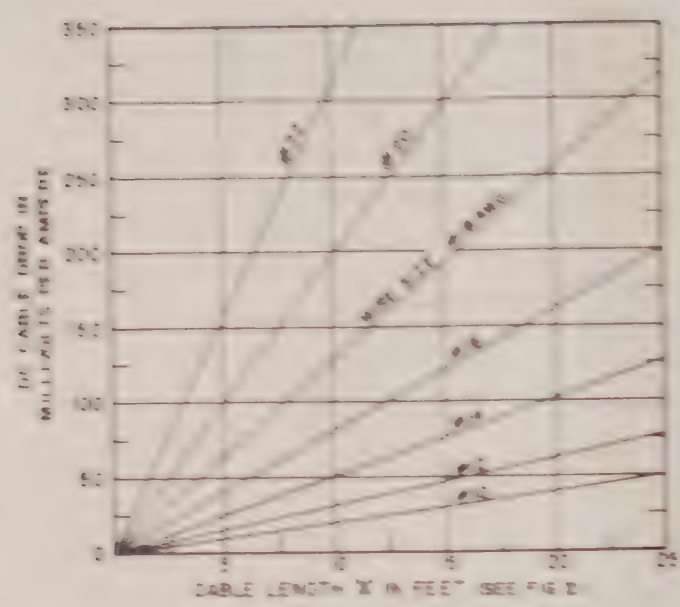


Figure 1 Cable Connection Chart

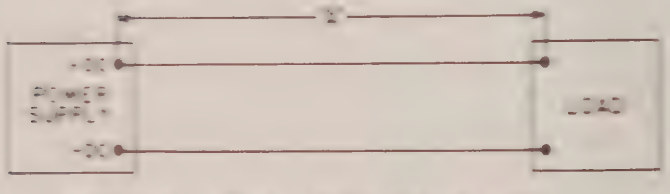
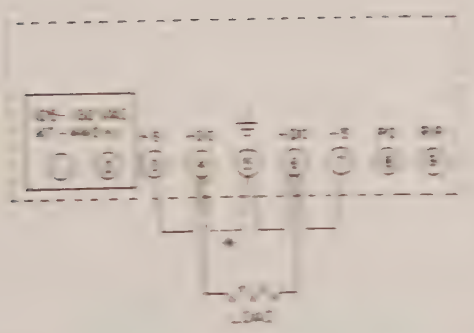
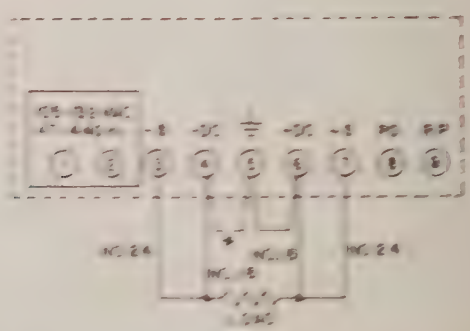


Figure 2 Cable Length "A" in Feet



NOTE
* FOR NEGATIVE GROUND DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5

Figure 3. Local Sensing Connection



NOTE
* FOR NEGATIVE GROUND DISCONNECT JUMPER FROM TERMINALS 5 AND 6 AND RECONNECT TO TERMINALS 4 AND 5

Figure 4. Remote Sensing Connection

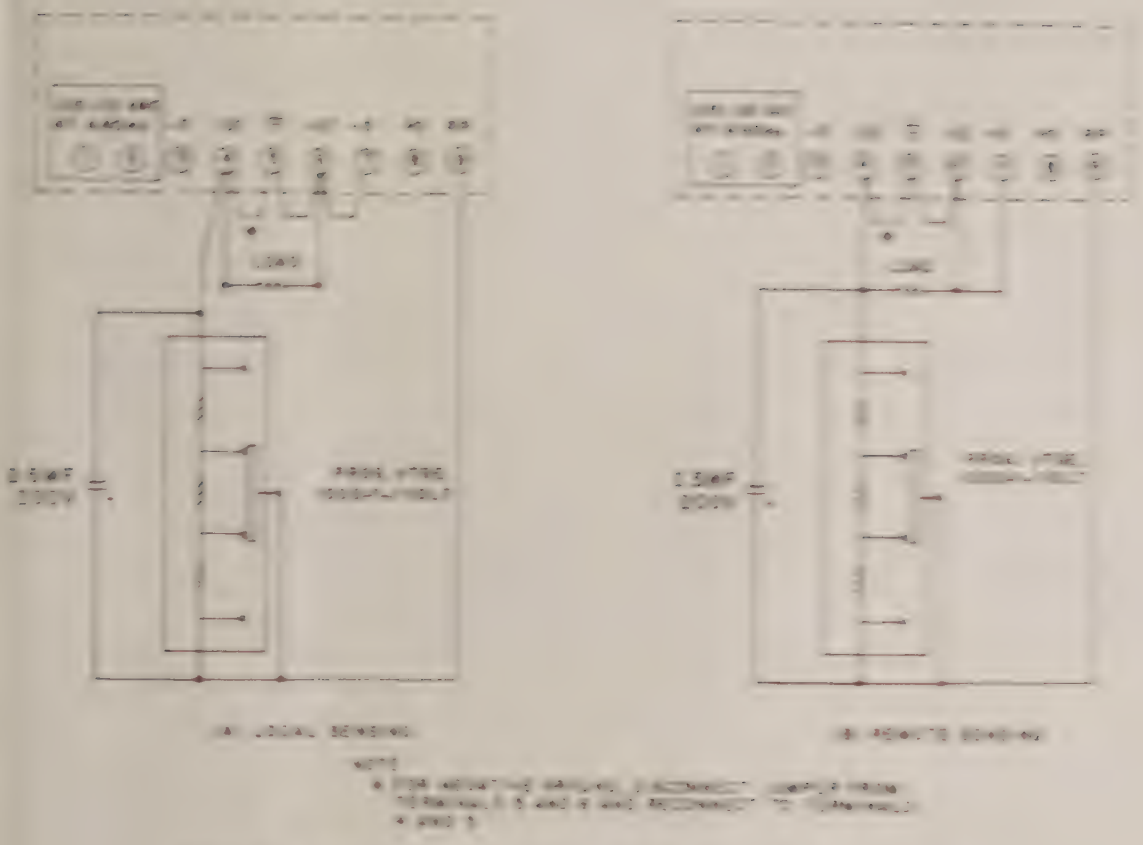


Figure 5. Programmed Voltage, With External Sensing

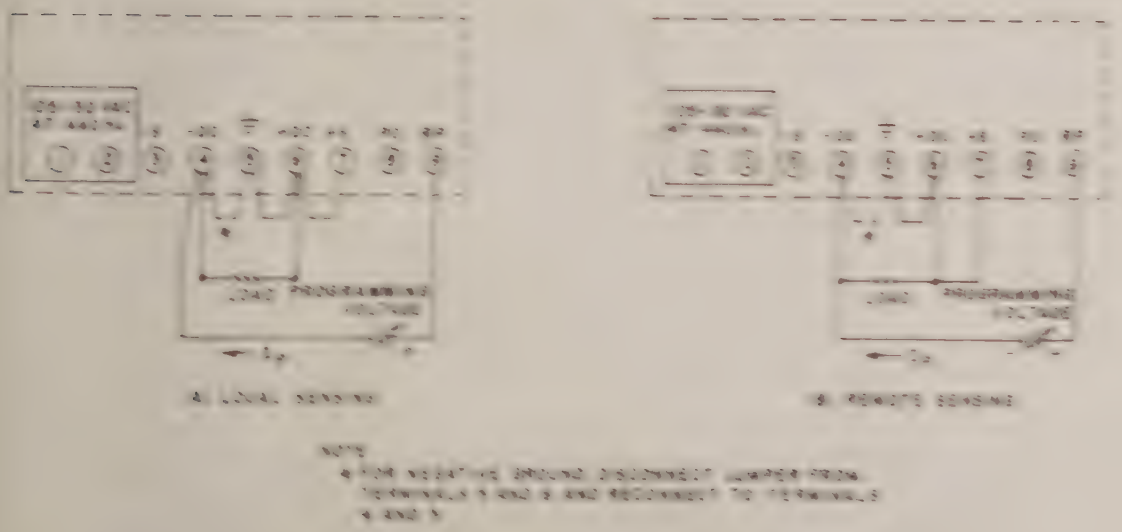
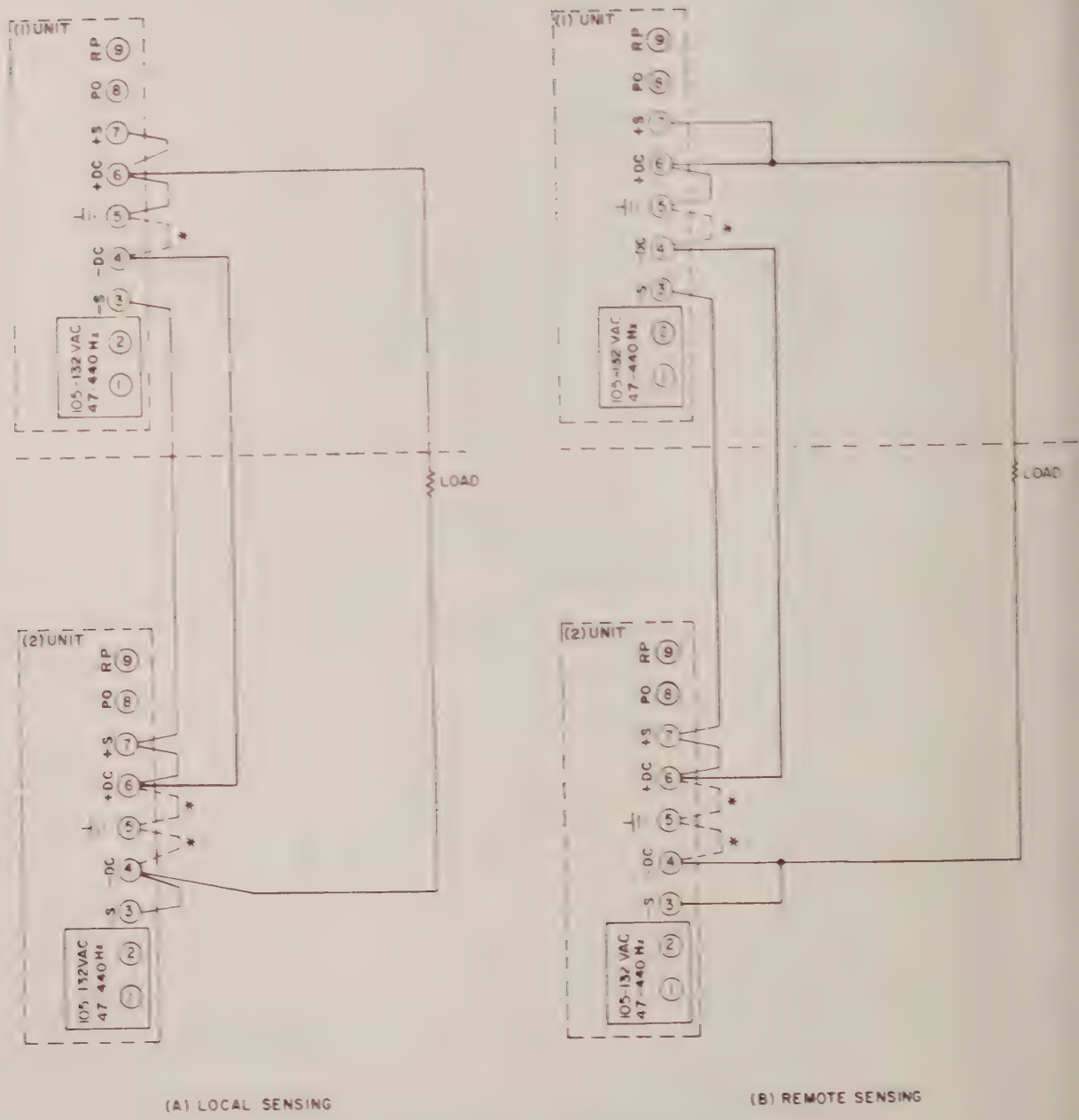
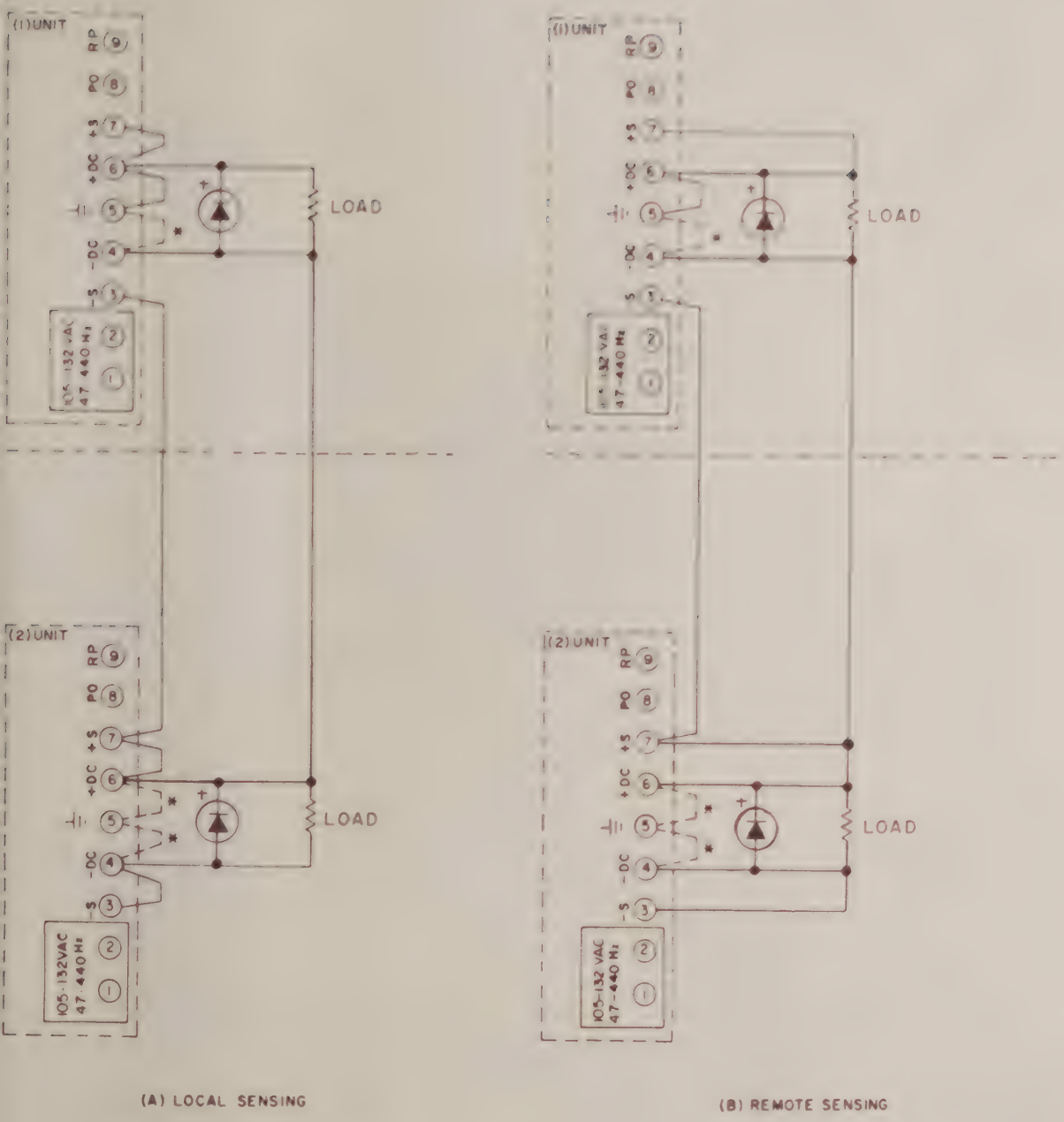


Figure 6. Programmed Voltage, With External Programming Voltage Source



NOTE
* MAKE ONLY ONE GROUND CONNECTION FOR THE SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON (1) UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE

Figure 7. Series Connection, Common Load. (LCS-CC-01 through LCS-CC-03 Only)



(A) LOCAL SENSING

(B) REMOTE SENSING

NOTE

* MAKE ONLY ONE GROUND CONNECTION FOR THE SERIES COMBINATION; TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 6 ON (1) UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE

† DIODES NOT REQUIRED FOR MODELS LCS-CC-01 THRU LCS-CC-03.

Figure 8. Series Connection, Dual Load.

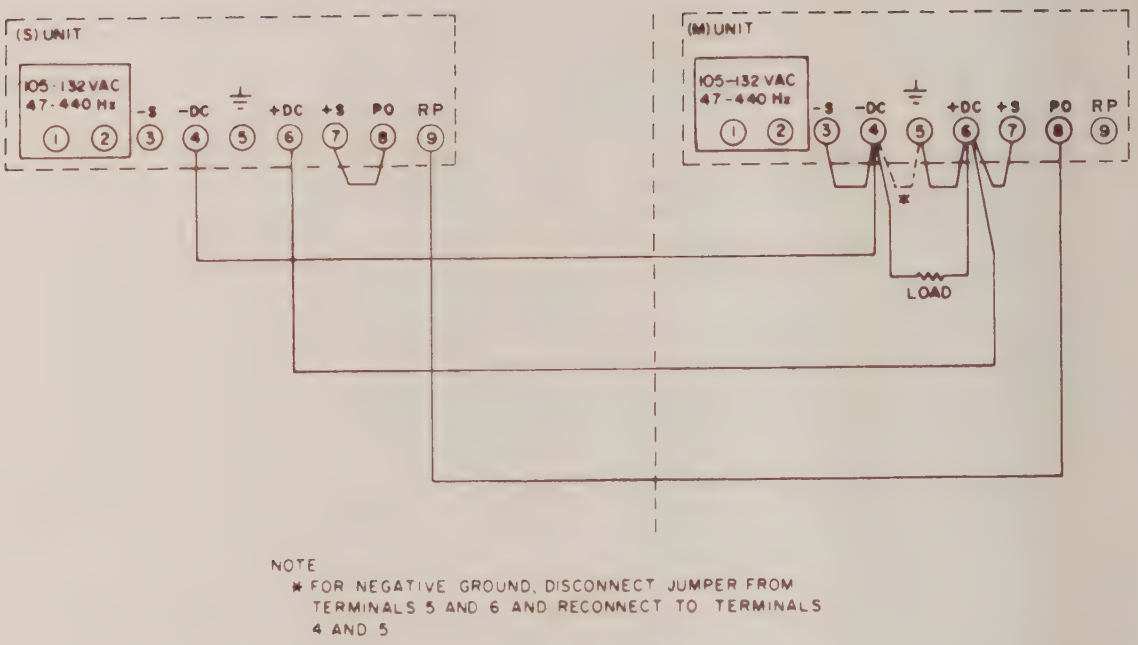


Figure 9. Parallel Connection, Local Sensing. (LCS-CC-01 through LCS-CC-03 Only)

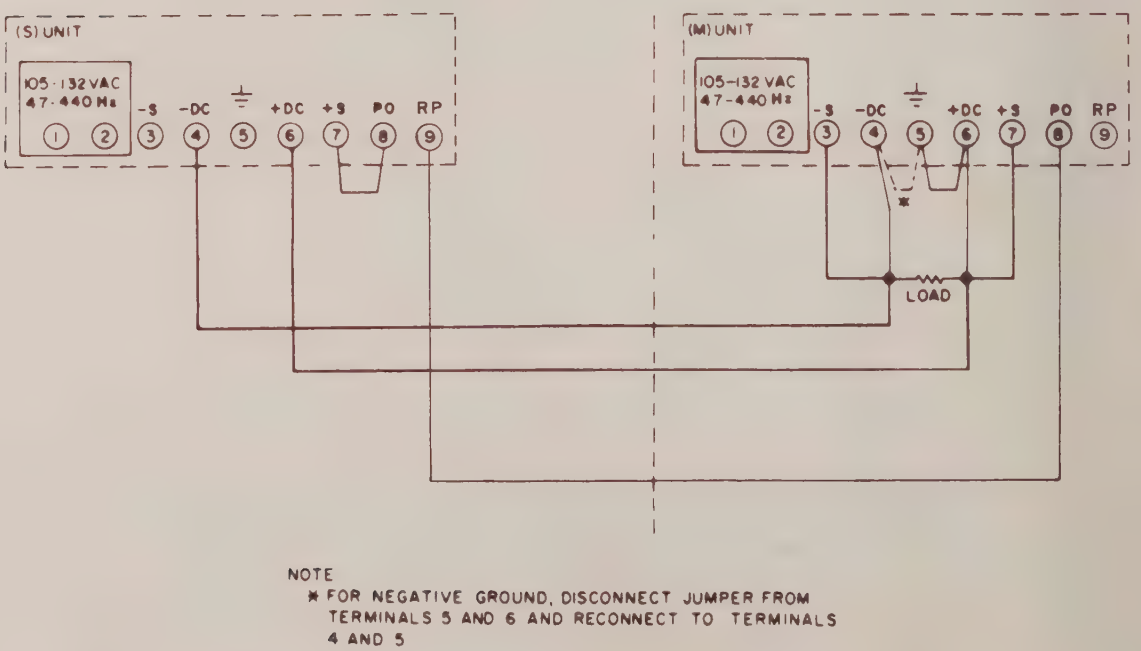
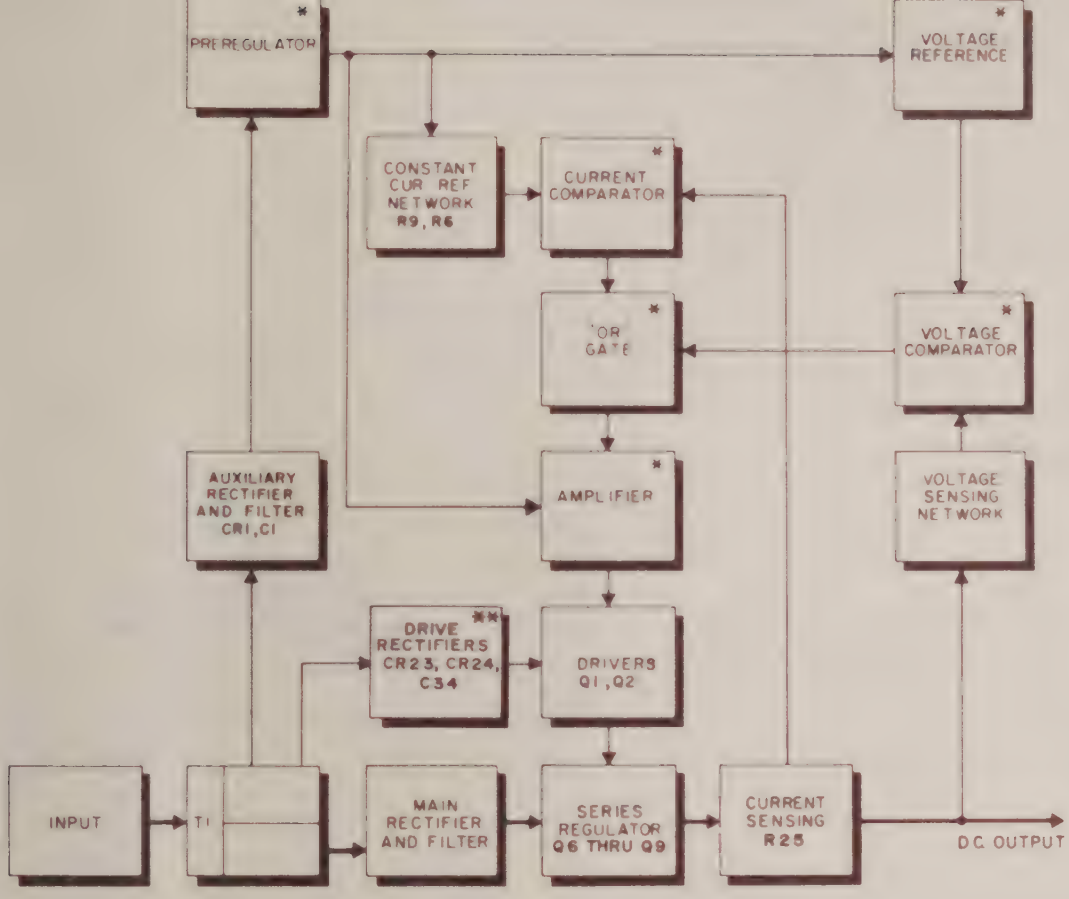
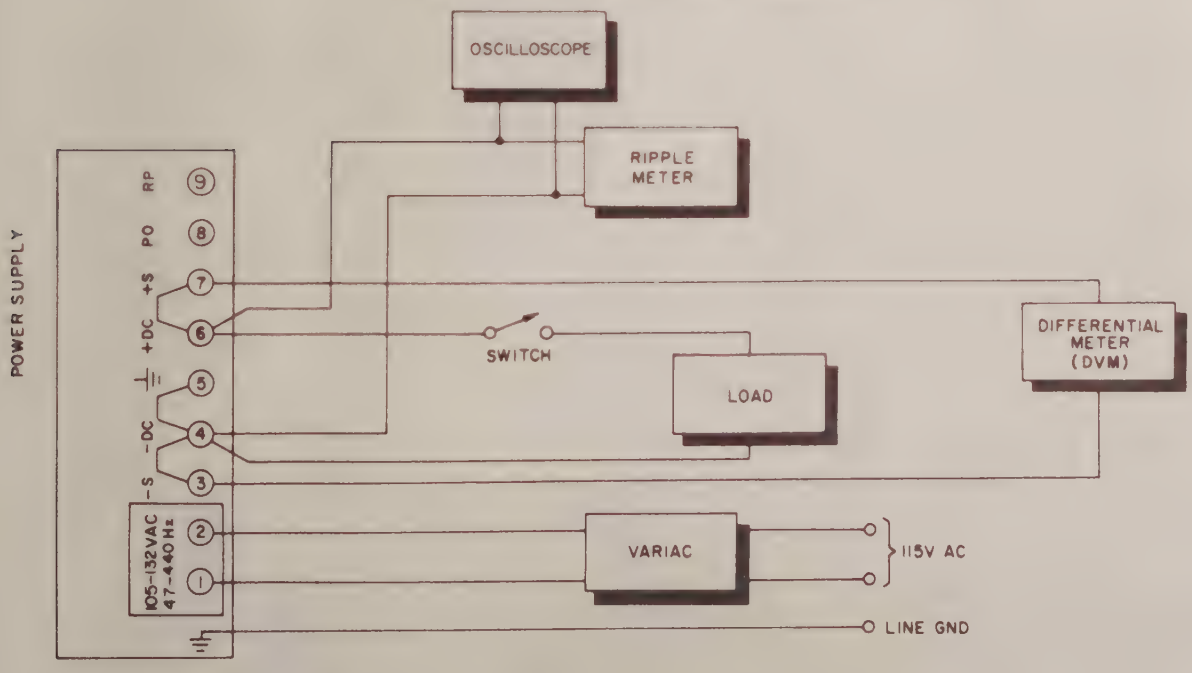


Figure 10. Parallel Connection, Remote Sensing. (LCS-CC-01 through LCS-CC-03 Only)



* THIS CIRCUIT ELEMENT IS LOCATED IN IC1.
** LCS-CC-2, LCS-CC-5-0V, LCS-CC-6 AND LCS-CC-01 ONLY.

Figure 11. Typical Block Diagram.



NOTES

1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE-WIRE LINE CORD TO GROUND
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTIONS ONLY

Figure 12. Test Connections For Constant Voltage Performance Checks.

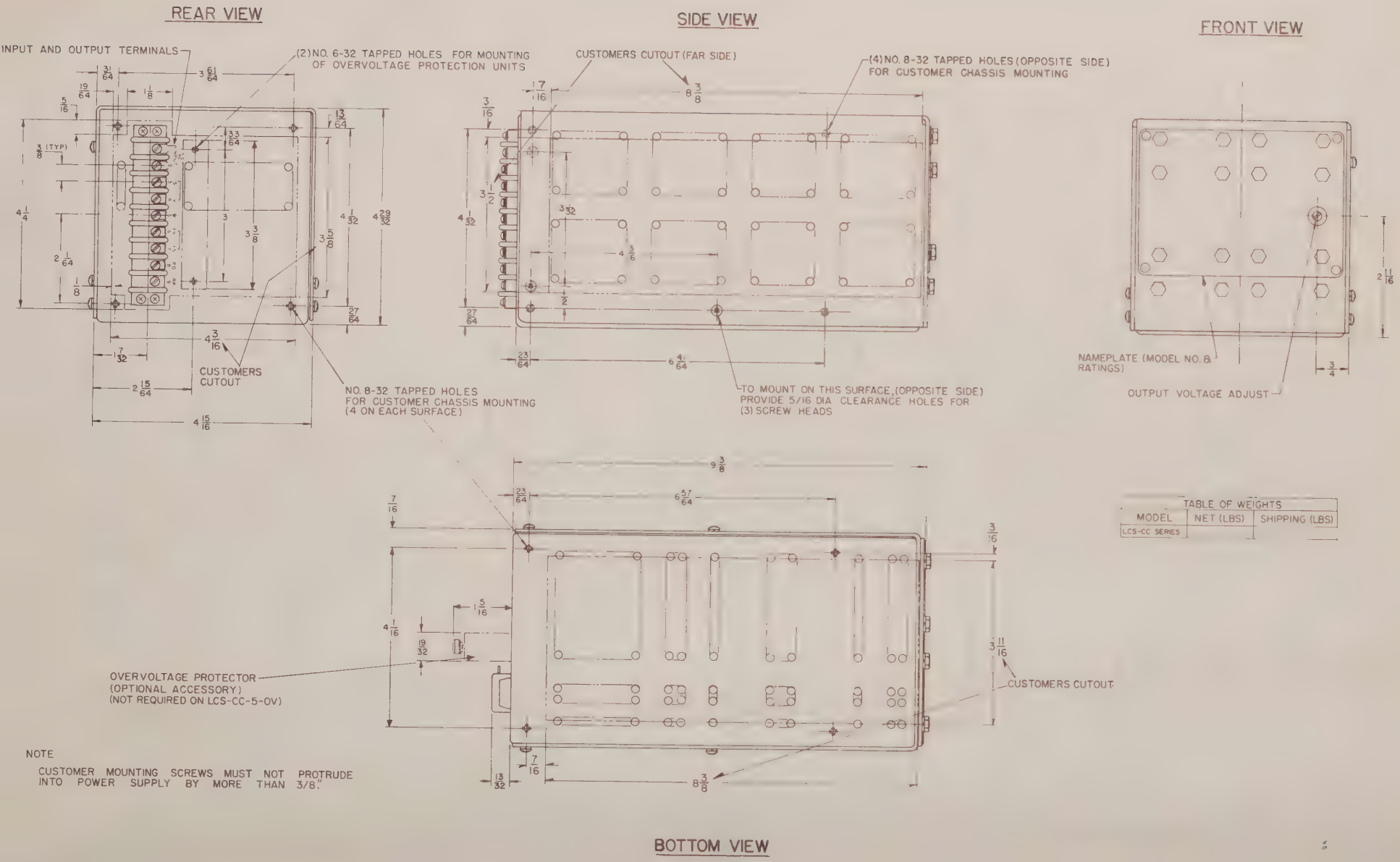
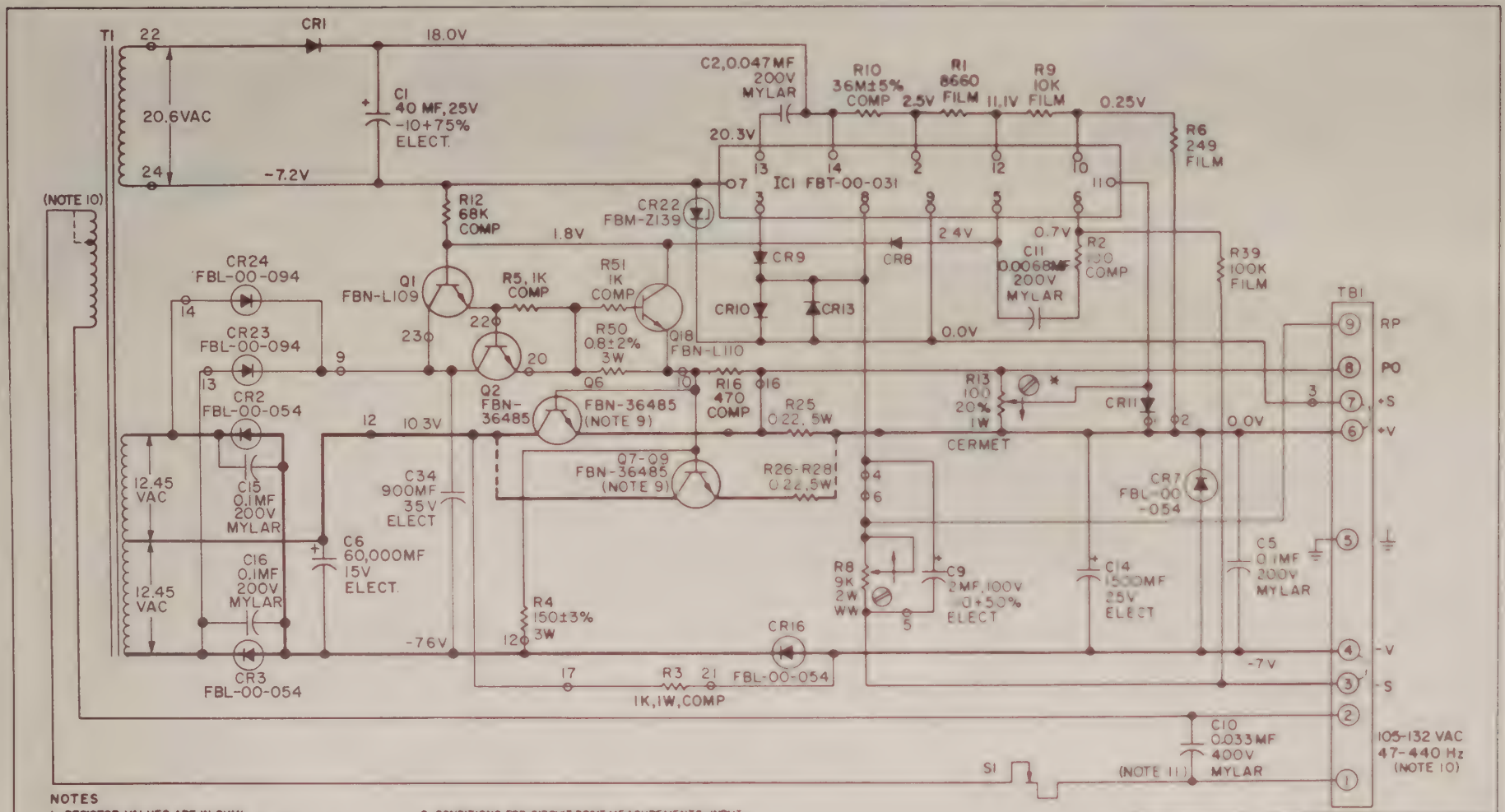

REAR VIEW
SIDE VIEW
FRONT VIEW
INPUT AND OUTPUT TERMINALS
(2) NO. 6-32 TAPPED HOLES FOR MOUNTING OF OVERVOLTAGE PROTECTION UNITS
CUSTOMERS CUTOUT (FAR SIDE)
(4) NO. 8-32 TAPPED HOLES (OPPOSITE SIDE) FOR CUSTOMER CHASSIS MOUNTING
CUSTOMERS CUTOUT
NO. 8-32 TAPPED HOLES FOR CUSTOMER CHASSIS MOUNTING (4 ON EACH SURFACE)
TO MOUNT ON THIS SURFACE, (OPPOSITE SIDE) PROVIDE 5/16 DIA CLEARANCE HOLES FOR (3) SCREW HEADS
NAMEPLATE (MODEL NO. & RATINGS)
OUTPUT VOLTAGE ADJUST
OVERVOLTAGE PROTECTOR (OPTIONAL ACCESSORY) (NOT REQUIRED ON LCS-CC-5-OV)
CUSTOMERS CUTOUT
BOTTOM VIEW
NOTE
CUSTOMER MOUNTING SCREWS MUST NOT PROTRUDE INTO POWER SUPPLY BY MORE THAN 3/8".

TABLE OF WEIGHTS

MODEL	NET (LBS)	SHIPPING (LBS)
LCS-CC SERIES		

Figure 13. Outline Drawing.



NOTES

1. RESISTOR VALUES ARE IN OHMS
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±5% FILM ±1%; UNLESS OTHERWISE NOTED
4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%, CERAMIC 10%, UNLESS OTHERWISE NOTED.
5. SYMBOLS
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030, USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER
7. DERATE CURRENT 10% FOR 47-53Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS INPUT: 115 VAC, 60Hz, MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM 7) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. ON MODELS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
11. ON UNITS WITH "V" OPTION, C10 IS 0.01MF±10%, 1000V, PAPER.

MODEL
LCS-SC-01

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

LAMBDA

ELECTRONICS CORP

MELVILLE, L.I., NEW YORK

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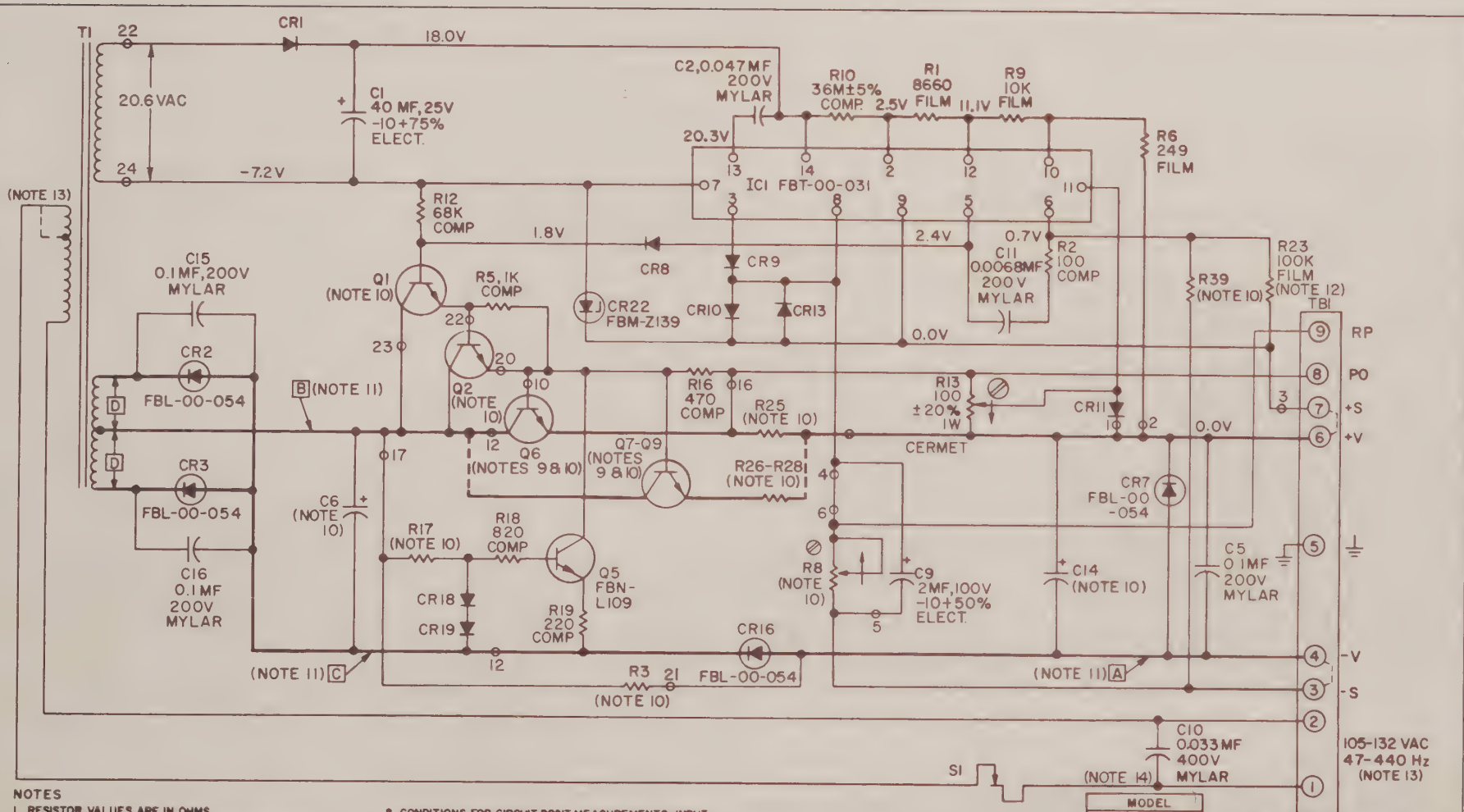

NOTES

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2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED.
4. CAPACITOR TOLERANCES ELECTROLYTIC -10%, +100%, MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - INDICATES CLOCKWISE ROTATION OF SHAFT.
   - INDICATES CONNECTION TO CHASSIS
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT #FBL-00-030, USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED. INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER
7. DERATE CURRENT 10% FOR 47-53 Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz, MAX. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES.
12. R23 ONLY USED ON MODEL LCS-CC-03.
13. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
14. ON UNITS WITH "V" OPTION, C1 IS 0.01MF±10%, 1000V, PAPER.

MODEL
LCS-CC-02
LCS-CC-03

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

LAMBDA

ELECTRONICS CORP

MELVILLE, L.I., NEW YORK

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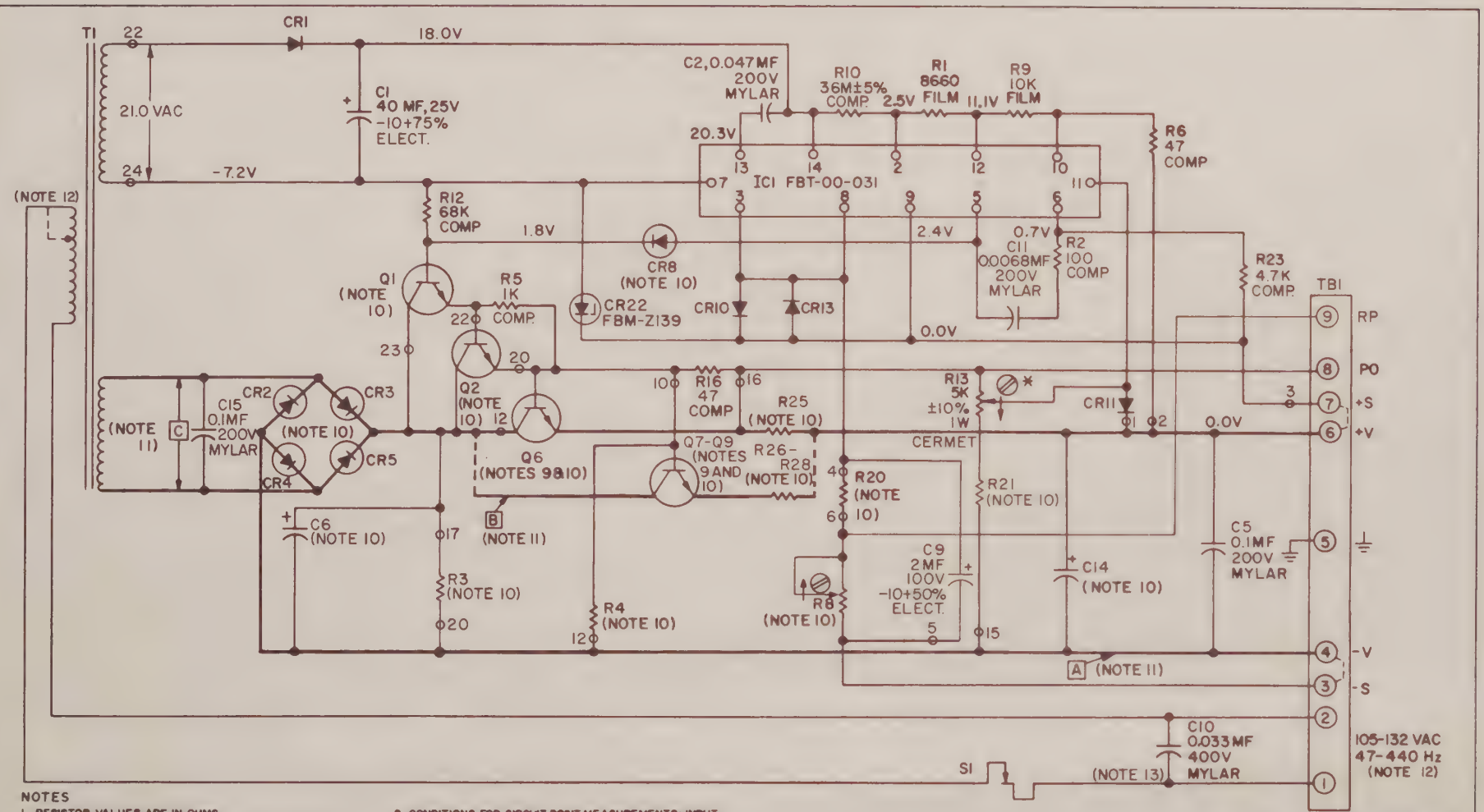
TABLE I
SCHEMATIC DATA REFERENCES
MODELS LCS-CC-02 AND LCS-CC-03

Models	Schematic Voltage Measurements				Schematic Components									
					C6	C14	Q1	Q2	Q5-Q9	R3	R8	R17	R27, R28	R49
	A (Vdc)	B (Vdc)	C (Vdc)	D (Vac)	-10+100% ELECT	-10+100% ELECT	*FBN	*FBN	*FBN	1W COMP	2W WW	1W COMP	1W WW	1W
LCS-CC-02	- 18	14.4	—18.6	23.7	22,000 mf 40 vdc	500 mf 60 vdc	L109	36485	36485	1.5K ±5%	22K ±5%	1.5K ±5%	0.5 ±5%	100K ±1% FILM
LCS-CC-03	—32	22.6	—32.6	38.6	13,000 mf 60 vdc	200 mf 100 vdc	L115	35902	36220	10K ±5%	10K ±2%	10K ±10%	0.01 ±2%	220K ±10% COMP

*Lambda part number



NOTES

1. RESISTOR VALUES ARE IN OHMS
2. RESISTOR WATTAGE 1/4 WATT; RESISTORS ABOVE 2 WATTS ARE WIREWOUND UNLESS OTHERWISE NOTED
3. RESISTOR TOLERANCES: COMP. ±10%; WIREWOUND ±2% FILM ±1%; UNLESS OTHERWISE NOTED
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   - INDICATES CONNECTION TO CHASSIS
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
   - SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030; USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
   - INDICATES TERMINAL ON PRINTED WIRING BOARD.
6. DESIGNATION IS LAMBDA PART NUMBER
7. DERATE CURRENT 10% FOR 47-53Hz, FOR 63-440Hz CONSULT FACTORY.
8. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 115 VAC, 60Hz; NOM. RATED VOLTAGE NO LOAD. INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER BETWEEN +S (TERM. 7) & INDICATED POINTS UNLESS NOTED; +S AND +V SHORTED, -S AND -V SHORTED
9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. SEE TABLE I FOR COMPONENT VALUES.
11. SEE TABLE I FOR VOLTAGE VALUES
12. ON UNITS WITH "V" OPTION, T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
13. ON UNITS WITH "V" OPTION, C10 IS 0.01MF±10%, 1000V, PAPER.

MODELS	
LCS-CC-12	LCS-CC-24
LCS-CC-15	LCS-CC-28
LCS-CC-20	LCS-CC-48

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

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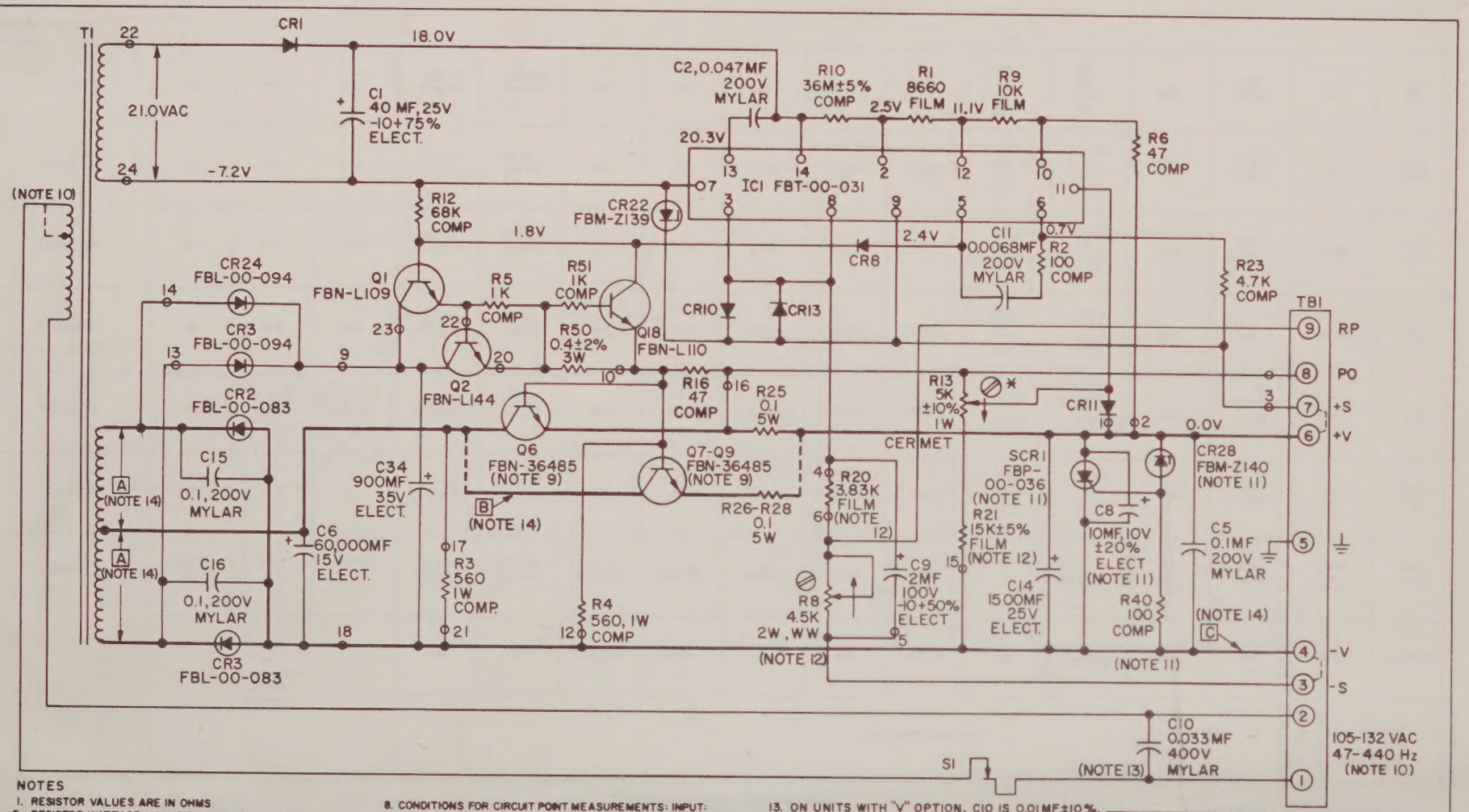
TABLE I
SCHEMATIC DATA REFERENCES
MODELS LCS-CC-12 THRU LCS-CC-48

Models	Schematic Voltage Measurements			Schematic Components												
				C6	C14	CR2-CR5	CR8	Q1	Q2	Q6-Q9	R3	R4	R8	R20	R21	R25-R28
	A (Vdc)	B (Vdc)	C (Vac)	-10+100% ELECT	-10+100% ELECT	*FBL-00-	*FBL-00-	*FBN-	*FBN-	*FBN-			±5% 2W WW	¼ W FILM	±1% ¼ W FILM	±5% WW
LCS-CC-12	-12	14.5	18.7	22,000 mf 40 vdc	900 mf 35 vdc	083	030	L109	36485	36485	1.8K ±10% 1 W COMP	1.8K ±10% 1W COMP	13K	9.09K ±1%	50K	0.22 5 W
LCS-CC-15	-15	15.5	21.5	22,000 mf 40 vdc	900 mf 35 vdc	083	030	L109	36485	36485	1.8K ±10% 1 W COMP	1.8K ±10% 1W COMP	13K	9.09K ±1%	50K	0.22 5 W
LCS-CC-20	-20	20.0	28.0	13,000 mf 60 vdc	500 mf 60 vdc	054	030	L109	36220	36220	2K ±3% 3W WW	4.7K ±10% 1 W COMP	15K	15K ±5%	66.5K	0.39 5 W
LCS-CC-24	-24	21.0	31.8	13,000 mf 60 vdc	500 mf 60 vdc	054	030	L109	36220	36220	2K ±3% 3W WW	4.7K ±10% 1W COMP	15K	20K ±1%	100K	0.39 5 W
LCS-CC-28	-28	21.5	35.0	13,000 mf 60 vdc	500 mf 60 vdc	054	030	L109	36220	36220	2K ±3% 3W WW	4.7K ±10% 1W COMP	15K	20K ±1%	121K	0.39 5 W
LCS-CC-48	-48	30.0	55.2	4,000 mf 100 vdc	200 mf 100 vdc	054	036	L115	35902	35902	5.6K ±3% 3W WW	9K ±3% 3W WW	23K	40.2K ±1%	121K	0.5 3 W

*Lambda part num



NOTES

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4. CAPACITOR TOLERANCES: ELECTROLYTIC -10%, +100%; MYLAR ±10%; CERAMIC 10%; UNLESS OTHERWISE NOTED.
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   - INDICATES CONNECTION TO CHASSIS
   - INDICATES ADJUSTMENT OR CALIBRATION CONTROL. * SEE INSTRUCTION MANUAL.
   - LAMBDA PT. #FBL-00-030, USE IN 4002 DIODE FOR REPLACEMENT UNLESS OTHERWISE NOTED.
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7. DERATE CURRENT 10% FOR 47-53Hz, FOR 63-440Hz CONSULT FACTORY.
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9. COAT BOTH SIDES OF INSULATING WAFER WITH DOW CORNING NO. 340 SILICONE GREASE.
10. ON UNITS WITH "V" OPTION T1 HAS TAPPED PRIMARY. "V" OPTION UNITS CAN BE WIRED FOR 187-242V INPUT (USING TAP) OR FOR 205-265V INPUT (USING ENTIRE PRIMARY).
11. C8, CR28, R40 AND SCR1 ONLY USED ON MODEL LCS-CC-5-0V.
12. ON MODEL LCS-CC-2; R20 IS 1.47K, R21 IS 6.8K±2% R8 IS 2.2K.
13. ON UNITS WITH "V" OPTION, C10 IS 0.01MF±10%, 1000V, PAPER.
14. SEE TABLE I FOR VOLTAGE VALUES.

TABLE I
SCHEMATIC VOLTAGE VALUES

MODEL	A (VAC)	B (VDC)	C (VDC)
LCS-CC-2	6.55	7.3	-2
LCS-CC-5-0V	10.3	9.6	-5
LCS-CC-6	10.3	8.6	-6

MODELS
LCS-CC-2
LCS-CC-5-0V
LCS-CC-6

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO POWER SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS INDICATE JUMPERS IN PLACE FOR LOCAL SENSING "2-WIRE CONNECTION"

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5 - Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

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